CERTIFIED MAIL, RETURN
RECEIPT REQUESTED
P-596 485 231

September 10, 1987

Mr. Gary Guenther
Chief Environmental Response Division
Michigan Department of Natural Resources
Stevens T. Mason Building
530 W. Allegan
Lansing, MI 30028

Dear Mr. Guenther:

The enclosed report describes the August 18, 1987 environmental incident which occurred at BASF Corporation's Chemicals Division located in Wyandotte, Michigan. The report includes detailed conditions surrounding the Propylene Oxide loss, immediate safety and environmental actions taken and methods employed to contain and recover the material from the groundwater.

BASF is continuing to implement the most effective remedial action program possible. Please review the Extended Remedial Action Plan and offer any appropriate response before October 15, 1987. BASF's actions to date have been reviewed with Mr. Roy Schrameck and members of his District staff and the support from his group has been appreciated.

Regards,

H. Dale Roush
Manager
Quality Assurance and
Environmental Affairs

mh
Enclosure

cc: R. Schrameck, MDNR, Northville, MI CERTIFIED #P-596 485 232
R. Powers, EPA, Grosse Ile, MI

BASF CORPORATION

ENVIRONMENTAL INCIDENT REPORT

The Chemicals Division, BASF Corporation, had a release of propylene oxide (PO) at the Wyandotte Site, Wyandotte, MI. The release was discovered about 6:30 p.m., Tuesday, August 18, 1987. The State of Michigan, the National Response Center, and local officials were notified by telephone. Based on a careful review of plant inventory completed August 21, 1987, we subsequently determined that 54,000 to 58,000 gallons of propylene oxide was lost to the ground from a leaking underground pipeline over a ten (10) to fourteen (14) day period. A second notice which updated the lost quantity was provided to the above agencies on August 21.

As required by our Emergency Response Plan, BASF immediately shut down and secured the production facility and flooded the immediate area with the deluge system and fire hoses. More than 3,000,000 gallons of water was applied over a two-day period. As soon as the safety of personnel and the facilities could be assured, BASF excavated several pits (Figure 1) surrounding the spill site, then began extracting groundwater from the affected areas in order to contain the loss by establishing a clear cone of depression in the groundwater table which centers around ground zero (Figure 2). This immediate containment action is providing a base to effectively measure continued containment and the elimination of adverse environmental impact.

The water from the pits is temporarily held in a lined pond on site where the natural reaction of PO to glycols is occurring. Periodic analysis of the water collected through August 28, 1987 (Table 1) clearly shows the contamination potential is under control and is being quickly reduced to a situation where in-situ biodegradation will naturally and effectively control the situation. Propylene oxide and its water reaction products are soluble and easily biodegraded[1][2][5]. The water reaction products are non-toxic glycols. BASF has collected numerous groundwater samples from throughout the affected area and has demonstrated that 70-90% of the propylene oxide has been converted to glycols.

During August 20-24, 1987, the combined recovery rate from the pits averaged 100 gpm. Due to the low transmissivity of the underlying soils and the declining recovery rate, the extraction gradually declined to about 45 gpm on August 28. Based on previous investigations of the site, the limited recharge rate will further reduce the average extraction rate to about 10 gpm. Most of the water removed at the higher pumping rates entered the water table because about 3,000,000 gallons of water was applied to the area of the release over a two-day period as a safety measure.

On August 24, 1987, the elevation of the water level in the pits was surveyed. On the same day, the water level was also measured in piezometers existing in the vicinity of the tank area (Figure 1) and the Detroit River. Except for pits 6, 8, and 15 which were dry, these measurements are shown on Figure 2. The configuration of the water table (Figure 2) defined by these measurements indicates that pumpage from the pits created a large cone of depression at the vicinity of the leak area. Groundwater flowing through the leak area is captured by pumping the pits. A groundwater divide (a ridge on the water table) separates groundwater captured by pumpage from groundwater outside the leak area which continues to flow to the north toward Perry Place and to the east toward the Detroit River.

ADDITIONAL ACTIONS TAKEN

Based on the favorable results which were achieved within a short period after the detection of the leak, the following additional steps were taken to further increase the capture of contaminated groundwater:

1. Pits 4, 17 and 18 were deepened to about seventeen feet below land surface (to an elevation of about 567 feet) and completed as extraction wells 4E, 17E, and 18E by installing 18 feet of 12-inch diameter steel pipe with a perforated interval of about 9 feet at the bottom. Around the pipe, each pit was backfilled with crushed stone to the approximate elevation of the non-pumping average water table and with natural materials to the land surface.

2. Pits 1, 3, 5, 7, 9 and 16 were deepened to at least two feet below the water table and completed as piezometers 1P, 3P, 5P, 7P, 9P and 16P by installing 2-inch diameter pipe with the bottom half perforated. The pits were backfilled around the pipe in a manner similar to that of the extraction wells.

3. All other pits were backfilled to grade with natural materials.

4. A monitoring program consisting of the following was initiated:
   a. Weekly water-level measurements in the extraction wells and in the new and existing piezometers (P26, P27, P29, P30, P37 and P38) in the vicinity of the leak area.

   b. Weekly analysis for propylene oxide and propylene glycol(s) from the extraction wells 4E, 17E, and 18E.

INDEPENDENT EXPERTS

The initial corrective actions and the extended Remedial Action Program which follows take into account information and guidance provided by BASF consultants, Dr. James Dragun, Soil Chemist, Stalwart Environmental Sciences and Services, Inc., and S. S. Papadopulos, Groundwater Hydrogeologist of S. S. Papadopulos & Associates.

Dr. Dragun advises:

- Water transport will move the organic contaminants in the same direction as groundwater movement, but at a lesser rate than the actual movement of water[4].

- Propylene oxide and propylene glycol will absorb slightly onto soil because the molecular weight is greater than water[6]. These compounds include hydrophobic fragment that is attracted to hydrophobic surfaces. These chemicals do not have a net negative charge that would lead to repulsation from particle surfaces.

- Soil bacteria will degrade these chemicals fairly quickly if conditions exist to sustain a bacterial population. Satisfactory conditions have been confirmed by BASF as evidenced by determined bacterial counts ranging between 10^3 and 10^6 organisms/mL in the extracted groundwater (3)(6)(7).

- The glycol is an aliphatic alcohol which readily degraded to ketones and to aldehydes and in turn to organic acids(5)(8).

- Some soil bacteria have been shown to thrive in propylene oxide concentratiors as high as 333 mg/l. Propylene glycols are degraded at concentratiors in excess of 4,000mg/l(1)(2)(8).

S. S. Papadopulos acvises:

- A cone of depression has been established in the groundwater table in the area of the loss.

- A cone of depression can be maintained with the operation of wells in the area of the loss by maintaining the elevation of the wells at elevation 573 or less.

EXTENDED REMEDIAL ACTION PROGRAM

Based on the advice of BASF consultants and its knowledge of the site, the Extended Remedial Action Program shall consist of:

- Recompleting extraction wells 4E, 17E and 18E to base clay which is approximately 20 feet below the land surface.

- Maintaining a cone of depression in the water table in the area of the loss by keeping the water elevation in extraction wells 4E, 17E and 18E at 573 feet or less.

- Monitoring water elevations on a weekly basis in new piezometers 1P, 3P, 5P, 7P, 9P, and 16P and existing piezometers P26, P27, P29, P30, P37 and P38. (See Figure 3 for expected elevation of water table).

- Determination of the propylene oxide concentration in the water from the extraction wells on a weekly basis until the concentration is less than 250 mg/l for three consecutive samples. After which the analysis of propylene oxide will be discontinued.

- Determination of the total bacterial count in the water extracted from the wells throughout the Remedial Action period once a week.

- Determination of the propylene glycol in the water from the extraction wells on a weekly basis until the concentration of the glycol is less than 3,000 mg/l for three consecutive samples.

The Remedial Action Program will be complete when the analysis for propylene oxide and propylene glycol are both below their respective criteria levels for three consecutive samples and the bacterial concentration in the water being extracted is more than $1x10^2$ organisms/ml[2][3][4][6][7][8].

If the above criteria does not meet the objectives of the Remedial Action Program in the opinion of the State, BASF must be advised no later than October 15, 1987.

Re: BASF Spill
The levels for closing the [illegible] much?
Should comment be [illegible]?
Maggie

REFERENCES

(1) Hackman, E. 1978, Toxic Organic Chemical Noyes

(2) EPA Publication 440/1-75/045.

(3) Alexander M. 1981. Biodegradation of Chemical Science 211:132-138.

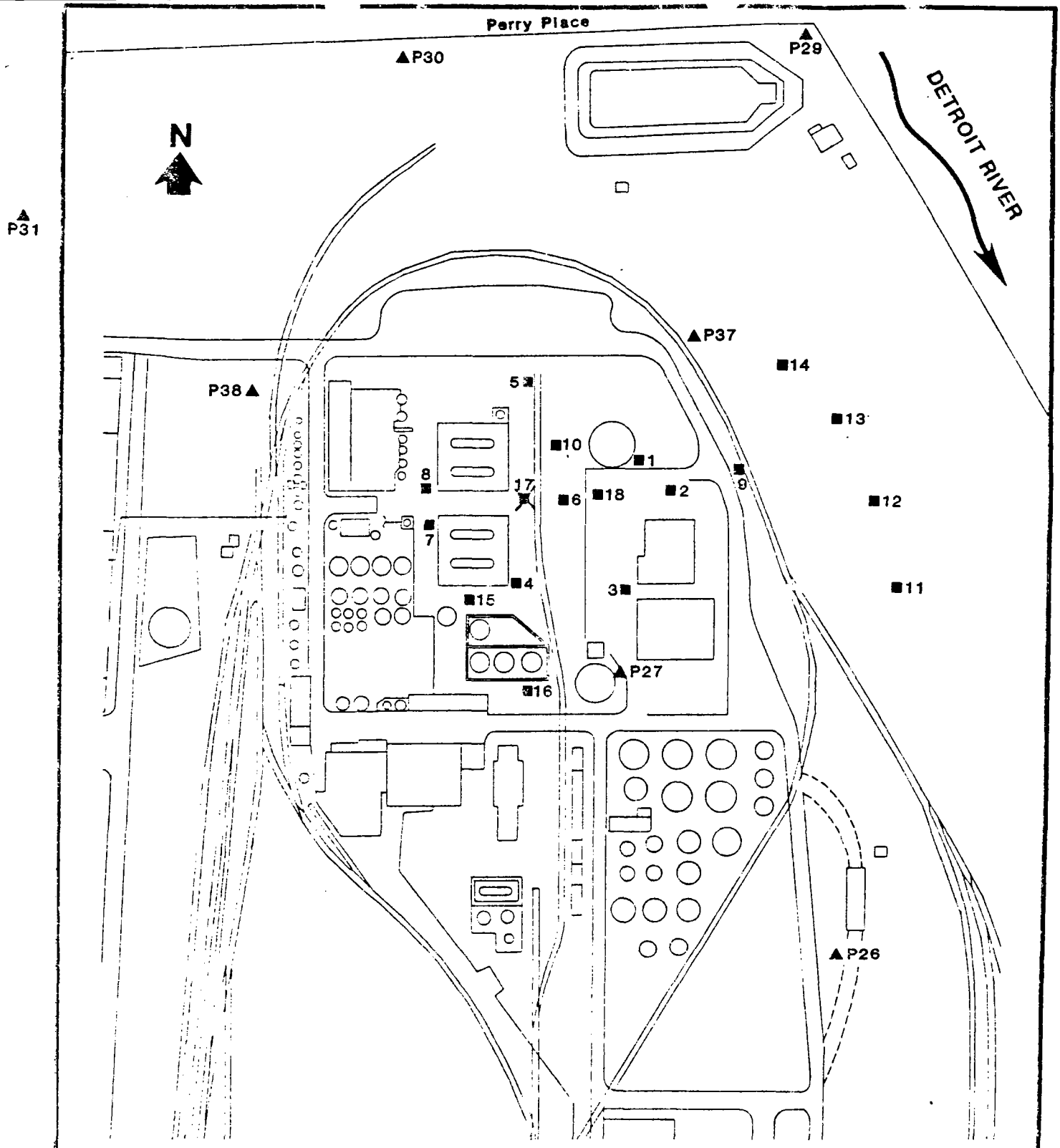
(4) Dragun J. Kuffner AC, and Schneiter RW, 1984. Groundwater Contamination - Part 1: Transport and Transformations of Organic Chemicals. Chemical Engineering 91:65-70.

(5) Geating J. 1981. Literature Study of Biodegradability of Chemicals in Water. Volumes 1 & 2. Franklin Research Center Report to the U.S. Environmental Protection Agency, EPA-600/2-81-175. P882-100843. Cincinnati, OH: U.S. Environmental Protection Agency.

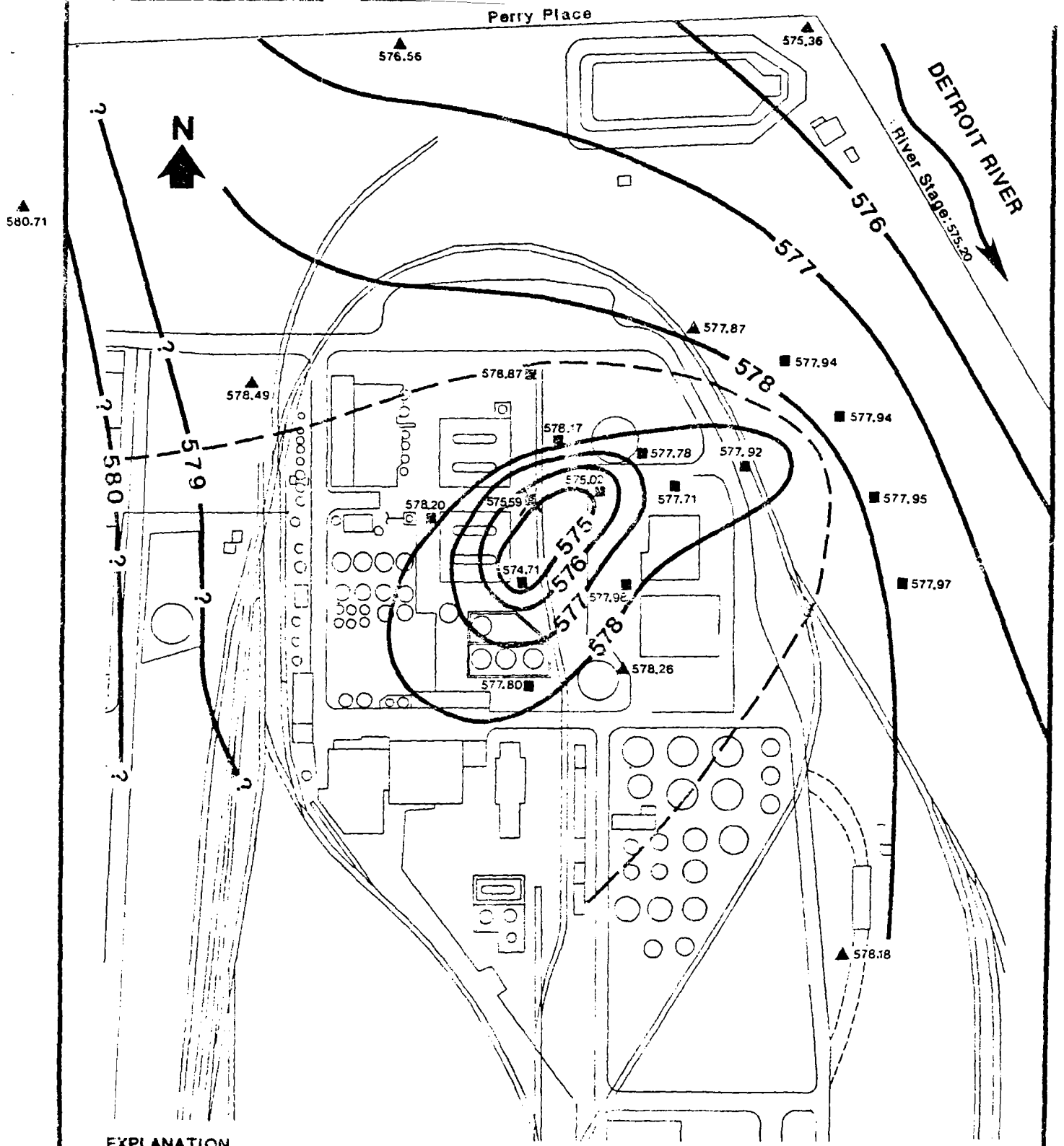
(6) Goring CAI and Hamaker JW (eds) 1972. Organic Chemicals in the Soil Environment. New York: Marcel Dekker.

(7) White A. Handler P. Smith EL, Hill RL, and Lehman IR. 1978. Principles of Biochemistry. New York: McGraw-Hill.

(8) Verschueren, K., 1983. Handbook of Environmental Data on Organic Chemicals, 2nd Edition. New York: Van Nostrand Reinhold Co.



BASF Corporation Chemicals Division Wyandotte Michigan	LOCATION OF PITS EXCAVATED NEAR THE LEAK AREA	FIGURE 1



EXPLANATION

578.87 ■▲ Location of pit (■) or piezometer (▲) and measured water table elevation, in feet above MSL.

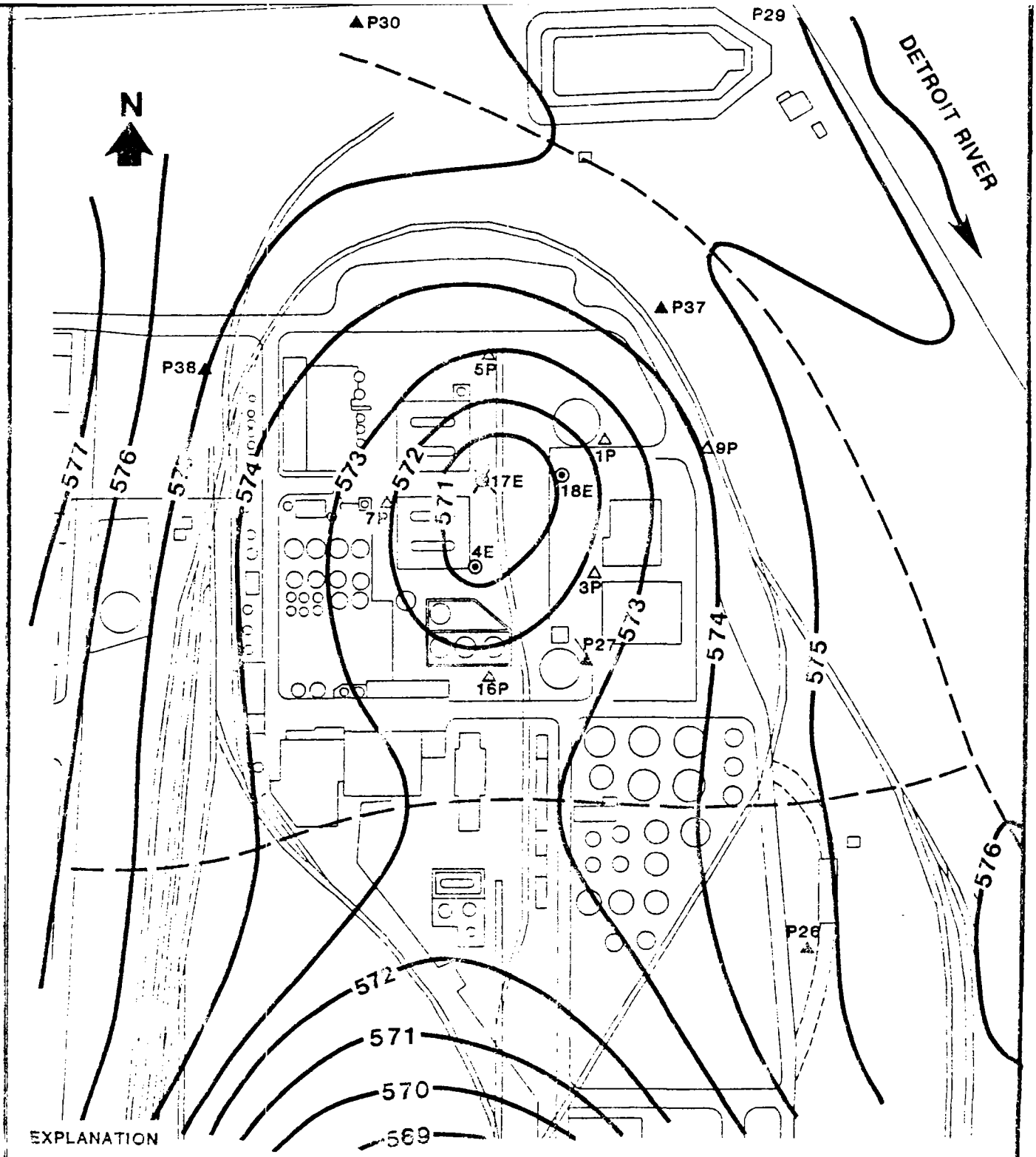
—577— Line of equal water table elevation, in feet above MSL.

— — — Ground-water divide.

Scale feet

0 20 40 60 80 100 200

BASF Corporation Chemicals Division Wyandotte Michigan	ELEVATION OF WATER TABLE NEAR LEAK AREA - AUGUST 24, 1987	FIGURE 2



BASF Corporation Chemicals Division Wyandotte Michigan	PREDICTED CONFIGURATION OF THE AVERAGE WATER TABLE	FIGURE 3

TABLE 1

GROUNDWATER ANALYSIS

Piezometer or Well	8/23/87 Concentration MG/L PO	PG	DPG	Maximum Concentration of PO 8/20-21/87, MG/L
1P	196	342	144	280,000
3P	3	7	2	15,000
5P	104	666	1	506
7P	2	20	6	101
9P	<1	8	2	266
15P	<1	14	4	26,000
P27	<1	ND	<1	<1
P30	<1	ND	<1	<1
P37	<1	2	4	<1
4E	128	92	24	539,000
17E	1,240	10,235	2,232	25,000
18E	145	1,587	184	12,000

Note: Although propylene glycol and dipropylene glycol analyses are not available for August 20-21, 1987, the above results clearly indicate effectiveness of the initial remedial action in reducing the concentrations of propylene oxide and its derivatives in the groundwater under the leak area and the potential for spread of the contamination has been halted.